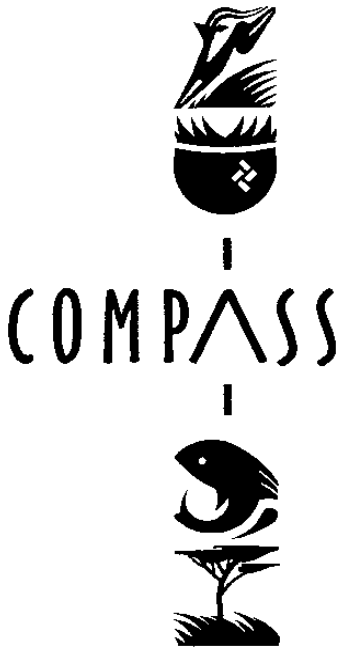

BUILDING GIS CAPABILITIES FOR THE COMPASS INFORMATION SYSTEM

INTERNAL REPORT 1
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COMPASS

Community Partnerships for Sustainable Resource Management in Malawi

Building GIS Capabilities for the COMPASS Information System

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List of Acronyms and Abbreviations

ADD	Agricultural Development Division
AVHRR	Advanced Very High Resolution Radiometer
CBNRM	Community-Based Natural Resources Managmenent
COMPASS	Community Partnerships for Sustainable Resources Management in Malawi
CURE	Coordination Unit for the Rehabilitation of the Environment
DAI	Development Alternatives, Inc.
DANIDA	Danish Development Agency
DfID	Department for International Development
EAD	Environmental Affairs Department
EIS	Environmental Information System
EPA	Extension Planning Area
FEWS	Famine Early Warning System
GIS	Geographical Information System
GPS	Global Positioning System
MAGIC	Malawi GIS Committee
MSS	Multi-Spectral Scanner
NGO	Non-Governmental Organization
NOAA	National Oceanographic and Atmospheric Administration
PROSCARP	Promotion of Soil Conservation and Rural Production Project
SADC	Southern Africa Development Community
TAMIS	Technical and Administrative Information System
TM	Thematic Mapper
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WSM	Wildlife Society of Malawi
WWW	World Wide Web

1. Introduction

1.1 The COMPASS Project

The Community Partnership for Sustainable Resource Management (COMPASS) initiative is part of USAID's approach to achieving its Strategic Objective Number 2 (SO2): Increased sustainable use, conservation and management of renewable natural resources in Malawi. A core team of professional staff mobilized in July of this year to initiate collaboration with NGOs, donor programs, Government of Malawi agencies, and the private sector to develop a strategy and a range of site-specific activities that will support community-based natural resources management (CBNRM) throughout the country. Based in Blantyre, the team of specialists includes experts in natural resources management, monitoring and evaluation systems, community mobilization and information management. The Environmental Affairs Department is the coordinating agency for COMPASS activities.

The five primary objectives of COMPASS are defined by the following Targeted Results (TR):

> TR1 – Building Malawian capacity amongst NGOs and government to administer CBNRM initiatives and provide the necessary technical support to practitioners;
>
> TR2 – Establishing efficient liaison, communication and information exchange mechanisms among CBNRM programs in Malawi and neighboring countries;
>
> TR3 – Improving community mobilization skills within the public and NGO sectors;
>
> TR4 – Supporting policy and legislative reform that assists improved resource management at the village level; and,
>
> TR5 – Providing small grants to CBNRM practitioners and promoters.

The purpose of this report is to outline a strategy and action plan for developing capacity within the COMPASS team to use spatial information as a means of achieving all these goals, but most directly TR2. The objective is to improve the use of and access to existing spatial databases, at the same time as developing new spatial data sets from which the COMPASS Information Management Specialist will generate and disseminate information to promote more effective CBNRM practices. Progress towards reaching this goal will be measured in terms of performance against a series of Sub Results (SR) and Activities that are defined in COMPASS Workplans. This report is the output from a specific activity defined in the first Workplan as follows:

SR2A – CBNRM Computer Information Network Designed

Activity 1 – Assess existing systems, resources, and capabilities and build the CBNRM computer-based information network

Step D – Geographical Information System (GIS) capacity established within the CBNRM Information Network.

COMPASS's interest in being able to manage spatial information stems from its recognition of the importance of *location* to promoters and practitioners of CBNRM. Knowing *where* resources are located is an essential piece of information for managers of those resources. Equally important is information describing the characteristics of those resources – what their defining attributes are, what condition they are in, how they are being managed and used, and who is involved in managing them.

1.2 Scope, Objectives and Approach of this Study

The primary objective of this assignment was to establish GIS capacity as a component of the COMPASS Information System. Another goal was to consider options for developing that capacity into a productive, efficient and sustainable means of generating useful CBNRM-related information, and to recommend the best options in terms of practicality, usefulness and cost-effectiveness. The most important product of the study is an action plan for putting into practice the recommendations made in this report. The action plan is presented in Chapter 4. Mr. David Craven, a GIS Specialist and staff member of Development Alternatives, Inc. (DAI), conducted the assignment over a 4-week period from September 17th to October 14th, 1999. The full Scope of Work for the assignment is included as Appendix I.

The GIS Specialist adopted a number of approaches to obtain the information he needed to complete the assignment. These included reviewing recent reports concerning information management in Malawi, interviewing people directly involved in the production and dissemination of CBNRM-related spatial information, discussing information needs with COMPASS professional staff, and examining the digital spatial data holdings of a number of key government and donor institutions. A list of the people interviewed is included in Appendix II, and a list of useful documents is included in Appendix III.

In addition to conducting research and evaluating options for developing COMPASS's spatial information management capacity, the GIS Specialist helped establish the foundation from which GIS can be developed into a useful and productive tool. COMPASS is now equipped with powerful GIS software (PC ArcView 3.1), the beginnings of a digital spatial database (see Appendix V), and an action plan which gives guidelines for further developing GIS capacity.

2. COMPASS and Digital Spatial Data

2.1 The COMPASS Information System

COMPASS's computer-based Information System will, when it is fully established, be comprised of 4 components – a Technical and Administrative Management Information System (TAMIS), a COMPASS Worldwide Web (WWW) site, an e-mail distribution list (ListServ), and a GIS capability. Databases developed and maintained for the 4 components will be stored on computers in the COMPASS office in Blantyre and in DAI's home office in Bethesda, Maryland, but access to those databases will be open to anyone who can log on to the WWW. Information generated from the various system components will also be made widely available to those without access to computers or. This will be done through public awareness and community mobilization campaigns using media such as radio, television, newsletters, best practices bulletins, presentations, and workshops.

Responsibility for managing the COMPASS Information System on a day-to-day basis rests with Mr. Mesheck Kapila. He is supported from time-to-time by short-term inputs from specialists in managing information, designing Web sites, customizing software, GIS, and other disciplines. The producers and users of information managed with the COMPASS Information System together form the COMPASS Information Network. A wide range of CBNRM partner organizations is represented in the Network, including community groups, government departments, NGOs, private firms, donors, and donor-assisted programs and projects.

2.1.1 TAMIS

TAMIS is a project management tool customized by DAI from Lotus NOTES software. The software enables multiple users to access and share a common set of information regardless of whether or not they are in the same geographic location. At present 7 partners have access to the TAMIS, all of them with specific interests in the management and administration of COMPASS activities. The currently registered partners are: COMPASS, the Wildlife Society of Malawi (WSM), the Co-ordination Unit for the Rehabilitation of the Environment (CURE), DAI in Maryland, USAID, Development Management Associates (a DAI subcontractor) and the Environmental Affairs Department.

TAMIS is comprised of a number of modules that present information in a variety of different ways to meet the needs of a range of users. The modules were designed following consultation with members of the COMPASS Information Network to determine user needs and format preferences. Currently TAMIS has 20 modules including Workplans, Reporting, Publications, Training and Workshops, Impact and Results, and Grants Management. The intention is to continue to modify the design of the system in response to new demands from partners as they become more familiar with its use.

2.1.2 COMPASS Web Site

COMPASS is currently receiving technical assistance to design its Web Site. Unlike TAMIS, which is accessible via the Web only to partners concerned with project management and administration, the COMPASS Web Site will be available for general access. Once the site is established COMPASS expects users representing a wide range of organizations and institutions to access the site. CBNRM partners from Malawi, the SADC region and throughout the world will log on to learn more about Malawi's natural resource concerns and the measures being taken by COMPASS and other initiative to address them. The site will have a strong graphics orientation, incorporating a range of maps, photographs, and links to other CBNRM-related sites.

2.1.3 COMPASS ListServ E-mail Distribution Service

The third component of the COMPASS Information System will be a ListServ e-mail distribution service. Acting as an electronic bulletin board, this service will provide all registered members with an efficient means of sending messages and disseminating information to their fellow CBNRM partners.

Examples of the types of information that will be shared through both the COMPASS Web Site and the ListServ include dates and venues of upcoming conferences and workshops, technical documents reporting the results of research and case studies, contact names and addresses, and examples of best practices in CBNRM.

2.1.4 COMPASS GIS

Much of the information disseminated via TAMIS, the Web Site and the ListServ will be spatial in nature. Partners will want to know *where* COMPASS and other CBNRM-support programs are working, *where* CBNRM practices are most effective, *where* the critical areas are as far as deforestation, soil erosion and water pollution are concerned, and *where* those "hot spots" are in relation to the National Parks, Forest Reserves, and other protected areas. To meet this demand for spatial information COMPASS will develop a GIS as the fourth component of its Information System.

The GIS will be used primarily as a mapping tool; it is not COMPASS's intention to build detailed technical databases for the purposes of compiling resource inventories or conducting sophisticated spatial analyses. These tasks are the responsibilities of government agencies such as the Departments of Forestry, Land Resources and Conservation, Surveys and Environmental Affairs. COMPASS is interested more in making existing spatial data more accessible and more useful to CBNRM partners than in collecting primary data and building new databases. To this end we will use GIS (and the other components of the Information System) to help raise awareness of information that is already available and to promote and facilitate information sharing.

2.2 Potential for Incorporating Spatial Information into the COMPASS Information System

COMPASS plans to use its GIS in a number of different ways to help it achieve the five Targeted Results listed in the introduction. It will use the *system* itself for database management, spatial analysis, and map production, and the *outputs* from the system for project management, information sharing, and monitoring and evaluation. It is this second category of applications that will be of most interest to our partners, and as such the ways we intend to use the GIS outputs are discussed in more detail below. In the following sections, the word "output" is generally used to refer to maps, although tables, charts, images and other graphics can also be generated with a GIS.

2.2.1 Project Management

COMPASS plans to use maps as project management tools for helping keep track of how and where project resources are being used. One way it will do this is by monitoring the distribution of proposed and ongoing COMPASS-supported activities in the field. Comparing this information with the distribution of CBNRM activities supported by other partners will help reduce the potential for duplicating efforts in one area or missing opportunities in areas that are being neglected. Other possibilities for project management mapping include the levels of participation in COMPASS-sponsored workshops, meetings and training programs. Maps of this kind will help the COMPASS team see if target audiences are being reached, participation is distributed as intended, and that there are no significant gaps. In a similar vein, mapping the distribution of newsletters, best practice case studies, Small Grant Manuals and other documents will help COMPASS management track the effectiveness of its outreach and public awareness campaigns.

2.2.2 Information Sharing

As means of disseminating information, maps can be very powerful communication tools. If they are done well they are the ideal medium for presenting spatial information, easily understood by a wide audience and generally more accessible than dense reports and tables of statistics. COMPASS's GIS-generated maps will play a significant role in its efforts to make information about CBNRM as accessible as possible. In addition to the management maps described above, COMPASS plans to publish and distribute maps of best practice sites, priority COMPASS districts and the locations of small grant-supported activities. State-of-the-environment maps will also be published, showing, amongst other things, the distribution of vegetation classes (including forests), soils, protected areas and high risk areas for deforestation, soil erosion, species loss and other resource threats. Maps like these will be accessible to a wide audience, either electronically or via more conventional media such as reports, newsletters, posters, and atlases.

2.2.3 Monitoring and Evaluation

The performance of COMPASS is being measured by a set of key indicators defined to measure progress towards each of the five Targeted Results. In addition, the overarching impact of CBNRM activities in Malawi is being monitored by another set of indicators. Many of these indicators can be mapped, and where this is the case, monitoring them spatially can be more effective than simple counts or checklists. As with all the maps described above, maps published for monitoring and evaluating performance and impact will be made widely accessible through the COMPASS Information Network. The key indicators that can be expressed spatially are listed below. Text in parentheses has been added to the definitions given in the first COMPASS Workplan (COMPASS, 1999).

Indicators measuring the overarching impact of CBNRM in Malawi (including but not limited to COMPASS)

- Number (and locations) of rural communities that have agreements with public sector agencies for sharing income from protected areas and/or jointly managing natural resources on public and communal lands.

- Extent of natural forest cover relative to the 1990/91 baseline.

- Suspended sediment yield at hydrological stations on main rivers, as an indication of levels of soil erosion (% change relative to 1998 baseline).

- Tonnes of fish landed from Malawi's 3 major lakes by subsistence and commercial fishers (locations of major fish landing sites).

- Populations of key wildlife species as an indicator of biodiversity.

Indicators for measuring COMPASS progress towards Targeted Result 1 – Effective CBNRM administrative and technical services capacity established.

- Percentage (location and extent) of land under customary ownership managed by entities adhering to CBNRM principles against 1994 baseline.

- Number (and locations) of districts with officially sanctioned CBNRM Action Plans against 1997 baseline of zero.

Indicator for measuring COMPASS progress towards Targeted Result 2 – Efficient liaison, communication and information exchange mechanisms among CBNRM programs established.

- Number (and distribution) of organizations and individuals registered as users of the COMPASS Information Network.

Indicators for measuring COMPASS progress towards Targeted Result 3 – Community mobilization skills within government, NGOs and community groups improved.

- Number (and locations) of communities where donor programs, NGOs, local authorities and others have conducted CBNRM awareness campaigns.

- Number (and distribution) of individuals participating in village-to-village and other exchange programs within Malawi and the region sponsored by COMPASS and others.

Indicator for measuring COMPASS progress towards Targeted Result 4 – Process of policy and legislative reform in favor of CBNRM supported.

- Number (and locations) of communities that have Village Natural Resource Committees (or similar) that help facilitate CBNRM agreements and promote activities.

Indicator for measuring COMPASS progress towards Targeted Result 5 – CBNRM small grant management services to finance special CBNRM opportunities established.

- Number (and location of origin) of formal applications for COMPASS grants received from qualifying organizations and individuals

Clearly COMPASS will not be alone in using GIS as a tool for supporting its CBNRM-support activities in Malawi. A number of government and non-government initiatives are well advanced in this regard, and COMPASS recognizes the need to coordinate with those institutions to provide mutual support, foster resource-sharing, and avoid duplication of effort. The next section identifies several areas in which ongoing efforts need strengthening and supporting, and in which COMPASS may be able to play a role.

2.3 Potential for Supporting Other Spatial Data Initiatives

The purpose of this section is to identify specific areas in which other producers and users of CBNRM-related spatial information in Malawi could benefit from some external support. The section does not include a detailed review of GIS capacity in other Malawian institutions and organizations because this has recently been well reported elsewhere (see Cutler, 1999, Mkandawire, 1999, and Kapila, 1999). What are discussed below are specific institutional weaknesses or gaps that need to be addressed to help sustain the development of GIS as a useful CBNRM tool in Malawi. Determining the extent to which that support is provided by COMPASS is beyond the scope of this report.

The Environmental Affairs Department (EAD) nominally plays a key role in managing and disseminating spatial information on a wide range of environmental issues and activities, including CBNRM. The primary responsibility of EAD in this respect is to coordinate the

national Environmental Information System (EIS) which is currently housed at the central office in Lilongwe. However, the Department's current capacity for filling this role is weak, even though it appears to have a good deal of support both internally and from external funding sources. The biggest constraints to EAD concern human resources.

EAD central office is well equipped with computer systems, databases, and software, including GIS, but the staff there do not have the skills they need to make the systems productive. Nobody at EAD is trained in GIS operations, or in other skills needed to manage the EIS, such as data collection, spatial analysis, and database management. **If the EIS is to be developed to meet its full potential, EAD must recruit an experienced GIS Analyst to manage it.**

Other measures that could help EAD meet its information management responsibilities concern strengthening the capacity of the District Environmental Offices. At present the burden on central office is simply too great – it does not have the manpower or the technical resources to do the work that is required. Many of the tasks required to build, maintain and use spatial databases could be assigned to district offices if the requisite hardware, software and skills are in place. Consistent with the current push for decentralization, financial and technical support to district EAD offices would relieve central office of some of its more mundane responsibilities, such as data collection, input and processing, and leave more resources available for managing and coordinating EIS development. UNDP and DANIDA have recently been providing support in this area by equipping district offices with computers, other office equipment and e-mail access. **Additional support specifically to promote district-level involvement in EIS development should include provision of GIS software, GPS receivers, and training in techniques for collecting, analyzing and managing spatial data.**

The Department of Forestry has one of the strongest GIS units in Malawi. In addition to a well-equipped laboratory dedicated specifically to Department activities, Forestry has a second facility supporting its role as Technical Coordinating Agency for SADC's forestry, inland fisheries, wildlife and biodiversity programs. Next month, the Department will install a satellite receiving station which will give it the capacity to receive NOAA's Advanced Very High Resolution Radiometer (AVHRR) data. At present Forestry has limited capacity to use these data, though the potential exists for a wide range of applications, including monitoring changes in vegetation cover, weather patterns, and the condition of water bodies. **The Department of Forestry needs technical support to develop applications for analyzing AVHRR data to reap maximum benefit from its new data source.**

With the possible exception of the Survey Department, GIS units in COMPASS partner organizations do not have the human resources they need to function effectively. This shortage of manpower is not only apparent among technical staff, but also among supervisory and management staff. One of the main reasons GIS units operate below their full potential is that the decision-makers responsible for managing financial, human and technical resources do not have adequate experience running GIS facilities. Even in units that are well staffed with competent technicians, weak management frequently limits productivity. This weakness stems not only from a lack of understanding of what is involved in making a GIS unit function and keep it functioning, but also because of a lack of awareness of the potential of GIS as a management tool. Where managers do not fully appreciate the potential of their technical staff, productivity often suffers from lack of direction, inadequate financial support, and low demand for GIS products. **Training is needed for both technical and supervisory**

GIS staff, most pressingly in the Land Resources and Conservation Department, in EAD central and district offices, and among the NGO community.

The need for training assumes an interest in acquiring new skills and capabilities, but that assumption may not be valid if the level of awareness about a new technology is low. Raising awareness among the CBNRM community about what GIS is, what it can do, and how to go about doing it is essential if even the moderate capacity currently in place in Malawi is to realize its full potential. **Through workshops, presentations, newsletters, Web sites and a range of other media, COMPASS can play an important role in raising awareness and marketing the products and services of GIS units to members of its Information Network.**

Another avenue through which CBNRM awareness-raising efforts are already being channeled is the CURE network of local, national and regional partners. CURE has a wide range of contacts throughout the region, and transmitting and receiving information through this network benefits both communities seeking to learn more about CBNRM practices and COMPASS partners trying to get a better understanding of conditions and circumstances in the field. At present, CURE publishes directories listing its partner organizations, providing contact details, and describing their interests and activities (for example, see CURE, 1998; CURE, 1997). Access to these documents would be greatly improved if they were published via the COMPASS Information System. **COMPASS could support CURE by publishing its directories of partners on the COMPASS Web Site.**

Finally, users' groups are an effective way of networking and sharing information, particularly popular in technical disciplines such as GIS and CBNRM. Plans to establish a GIS users' group in Malawi were hatched several years ago, but the group never materialized, even though there still seems to be a good deal of interest in forming one. In addition to promoting the products and services of its members, the role of a GIS users' group is to provide a forum for producers and users of spatial information to exchange ideas, experiences, technical support and data. Approaches to serving these functions vary from group to group, but common activities include publishing newsletters, holding conferences and seminars, publicizing conferences and seminars hosted by other organizations, maintaining mailing lists and directories of services, publishing technical papers, and hosting Web sites and bulletin boards on the Internet. Good models for this type of organization include the various ESRI Specialty Users' Groups based in the U.S.A., the GIMS Users' Group in South Africa, and the University of Arizona GIS Users' Group, also in the U.S.A. Information about these groups, including Web and e-mail addresses, are given in Appendix IV. **Initial efforts to establish the Malawi Geographic Information Committee (MAGIC) have stalled, but the demand for a users' group remains strong, and efforts should be made to revive it.**

In addition to contributing to efforts to address some of the issues discussed above, COMPASS will be seeking to develop GIS capacity to support both its own needs for spatial information and those of its CBNRM partners. Good progress has already been made in this regard, and the current status of the COMPASS GIS is the subject of the next chapter.

3. Current Status of COMPASS GIS Capacity

3.1 Hardware and Software

COMPASS is well-provided with new computer and peripheral equipment in its Blantyre office. Each member of the professional and administrative staff has access to a personal computer or a laptop, and the computers are networked through a powerful server. The office has modems and an account with Malawi.Net, providing it with access to the WWW and e-mail. COMPASS also uses Malawi.Net as its gateway to the information management and administrative support services provided by DAI's home office in the U.S.A. Computer peripherals include a black and white laser printer, a fax/scanner/ answering machine, and UPS protection for all computers.

The COMPASS Information System is built around a range of computer programs under the Microsoft Windows 95 operating system. The most important of these are Lotus Notes 4.6 and the Microsoft Office 97 suite (Word, Excel, Access and PowerPoint). Lotus Notes is the platform for TAMIS, providing registered partners with access to COMPASS's technical and administrative databases through the WWW.

Two powerful new programs were recently installed to establish GIS capacity as part of the Information System. These programs are ArcView 3.1 and Crystal Reports 6.0. ArcView is a popular desktop GIS program that will provide the COMPASS team, with the ability to manage, analyze and present spatial data and information. Crystal Reports is an extension to ArcView which can be used to generate reports from tabular databases. Used in tandem, these two programs give COMPASS the ability to present spatial information in maps, tables, charts and diagrams, in both electronic and hardcopy formats.

ArcView is recognized as the leading desktop mapping and GIS package available, and it is used by most of the institutions and organizations involved in GIS in Malawi. Though not as powerful in analytical terms as some of the more sophisticated programs available, ArcView has a number of advantages over the alternatives, including relative user-friendliness, a large user community, good desktop mapping capabilities, and low cost. Data formats supported by ArcView are broadly compatible with those used by other programs, and an import/export extension is provided with the software to facilitate data conversion and exchange.

3.2 Human Resources

Mesheck Kapila, COMPASS's Information Systems Specialist, is very experienced in remote sensing and GIS techniques and applications. He has a Master's degree in applied remote sensing from Silsoe College in the UK. He has also attended overseas training courses in land cover modeling (University of Arizona), advanced GIS and remote sensing (Clarke University) and remote sensing for environmental analysis and management (Indian Institute of Remote Sensing). In Malawi, Mr. Kapila has successfully completed a number of certificate courses in agrarian reform and land husbandry. Professionally he has contributed to a number of GIS-based studies including the Middle Shire River Situation Analysis, the Customary Land Utilization Study, and several land suitability and land use mapping studies.

Mr. Kapila's work experience includes spells as Land Husbandry Officer for Kasungu and Blantyre ADDs, lecturer in geography, remote sensing, meteorology and climatology at Chancellor College, and most recently, Task Force Team Leader for the Environmental Information System. Mr. Kapila is well-versed in a wide range of GIS applications and software, including ArcView.

Andrew Watson, the COMPASS Chief of Party, also has broad experience in remote sensing applications for land cover and land use analysis. Though this has usually been as a user rather than as a producer of GIS and remote sensing products, Dr. Watson is very aware of the value of spatial information, and he is familiar with the operation and functionality of a number of GIS programs, including ArcView.

Even with this experience on the team, COMPASS does not have the human resources to fully develop its GIS potential. A number of options are available to supplement its in-house capacity, and COMPASS will probably use all of them to some degree on an as-needed basis. The most likely sources of support are short-term technical assistance from consultants and collaboration with local GIS units such as the Survey Department and the Department of Forestry. **In addition, it is recommended that COMPASS and CURE collaborate in an arrangement whereby, in exchange for GIS equipment, software and training provided by COMPASS, CURE provides manpower to assist in spatial database development and use.** Given the mutual interests and close proximity of the two organizations, this is an excellent opportunity for them to collaborate. It is also an excellent opportunity to begin building GIS capacity at CURE with a view to sustaining COMPASS initiatives beyond the year 2004. At present, CURE has no GIS capacity, and if it is to fill the gap left when COMPASS closes, the two organizations must develop their capacities in tandem, and not wait until the last minute to transfer responsibilities.

3.3 Data

In terms of digital spatial data, COMPASS now has a solid foundation on which to build applications to provide useful information to the CBNRM community and to support its own performance monitoring and evaluation activities. The current COMPASS digital geographic data holdings are summarized below, and more details are provided in Appendix III. The data listed below are divided into two categories – geographic data describing *where* features are located, and attribute data describing *what* those features are like. The geographic data are further divided into reference data, which provide the information typically shown on topographic or base maps, and thematic data, which give information on a particular topic or theme such as the distribution of soils, land use or protected areas. The listings are described in terms of layers (comparable GIS terms include coverages and themes), the standard way of organizing data in a GIS database.

COMPASS Digital Geographic Data Holdings

Reference	Thematic
• Administrative Boundaries - Nation - Region - Agricultural Development Division - District - Extension Planning Area	• Protected Areas - National Parks - Wildlife Reserves - Forest Reserves - Proposed Forest Reserves
• Major Settlements	• Land Cover Units (1991)
• Transportation Routes (road and rail)	• Land Cover Units (1973)
• Airports/Airfields	• Agro-Climatic Zones
• Rivers and Streams	• Agricultural Schemes
• Lakes	• Soil Units

In terms of attribute data, COMPASS has a range of data sets describing the conditions and characteristics of the features included in the geographic layers listed above. COMPASS's geo-referenced attribute data sets are listed on page 13.

The human and technical resources described in this chapter provide COMPASS with a starting point from which it can begin to develop its information management activities from a spatial perspective. Chapter 4 presents a series of recommendations for initiating this process so that COMPASS can begin to use its GIS capacity productively.

COMPAS Digital Attribute Data Holdings

- Agro-Climatic Characteristics (from 1991/92 Land Resource Evaluation Project maps)
  - agro-climatic zone number
  - area of each zone
  - length of growing period
  - mean temperature during growing period
  - mean annual precipitation
  - mean annual temperature

- Agricultural Production by EPA, 1984-94 (from FEWS)
  - name of each EPA
  - area of each EPA
  - area planted to 13 different crops
  - yield per hectare by crop
  - total production by crop

- Population, 1987
  - name of each district and EPA
  - area of each district and EPA
  - total population by district and EPA
  - population density per sq. km.

- Soils (from 1991/92 Land Resource Evaluation Project maps)
  - area of each soil unit
  - soil type
  - soil associations (primary, secondary, other)

- Land Cover (from 1973 MSS and 1991 TM satellite data)
  - area of each land cover unit
  - codes for 11 land cover classes for 1973
  - codes for 26 land cover classes for 1991

- Protected Areas
  - area of each Protected Area
  - reserve name
  - reserve type
  - protection date
  - date gazetted
  - 1987 population within 5km of protected area, etc.

4. Action Plan for COMPASS GIS Development

The primary objective of this assignment was to establish GIS capacity as part of the COMPASS Information System. This has been done by installing software, assessing the spatial information needs of COMPASS and its partners, initiating the development of a baseline digital spatial data set to meet those information needs, developing pilot applications with that data set, and providing on-the-job training for the COMPASS Information Systems Specialist. A second goal was to lay out a strategy for effective use and continued development of GIS by COMPASS and its partners. Action items recommended as first priorities are summarized as follows:

- Start preparing maps from the existing spatial databases for publication on the COMPASS Web Site.

- Start preparing maps from the existing spatial databases for publication in the first edition of the COMPASS CBNRM Atlas of Malawi (target date for publication – June 30th, 2000.

- Determine and articulate *how* the data needed to track key COMPASS indicators will be collected, analyzed and presented.

- Begin to acquire key primary and secondary data sets missing from COMPASS databases.

- Start the process of establishing GIS capacity at CURE.

- Conduct a GIS training-needs assessment among COMPASS partners, targeting GIS operators, managers/decision-makers and data-collectors.

- Develop a GIS training program based on the results of the needs assessment.

- Organize the revival meeting of the Malawi GIS Users' Group (MAGIC).

- Procure equipment and supplies needed to make the COMPASS GIS fully operational.

- Incorporate the recommendations listed above into the COMPASS 2000 Workplan, and specify the timing and the level-of-effort required for each activity.

The following sections present more detailed guidelines for putting GIS technology to work to support the information needs both of COMPASS and of the wider Malawian CBNRM community. Recommendations are made for developing applications and producing outputs, building and expanding spatial databases, supplementing COMPASS's own technical and human resources, and meeting additional needs for equipment, supplies and data.

4.1 Generating Outputs from the COMPASS Spatial Databases

To define the range of options available to COMPASS for generating GIS outputs, it is useful to discuss those outputs in terms of content, form, and means of dissemination. *Content* refers to the subject matter of a map or image – the actual data presented to convey certain information or a particular message. *Form* refers to the style or design of the output – the way the content is presented. The form of an output is defined by such things as the size of the area covered, the scale of the map, the method of classifying and symbolizing data, and whether the map is to be reproduced in black and white or in color. *Disseminating* information on maps and images can be achieved in a variety of ways, determined to a large extent by the content and form of the maps. Options for disseminating GIS outputs include distributing large format prints as posters, using small format prints in reports and newsletters, and distributing maps electronically via Web sites, e-mail, CD, diskette or Zip cartridge. Mapped information can also be delivered to a target audience through audio-visual presentations using overhead, slide or computer-screen projectors. The COMPASS Information System will support all of these options, maximizing the size and diversity of the CBNRM community it hopes to reach.

Content – COMPASS plans to generate and distribute maps on a wide range of themes. Some of these it can begin to produce immediately from the databases it has already assembled; others can only be produced once the data needed to produce them has been acquired. A third group of maps will evolve with COMPASS as new data are generated on activities that have not yet begun (e.g. small grant disbursement).

Under the first category, COMPASS should begin to compile and publish maps of the following from its existing data holdings:

- Six Priority COMPASS Districts for CLIN 0001.
- Protected Areas of Malawi (National Parks, Wildlife Reserves, Forest Reserves, etc.).
- Land Cover, 1991.
- Land Cover, 1973.
- Land Cover Change, 1973 – 1991.
- Distribution of Soil Types.
- Average Annual Rainfall Variation.
- Average Annual Variation in Number of Dry Months.
- Average Annual Variations in Temperature (mean, minimum, maximum).
- Trends in Agricultural Productivity, 1984-1994 for major crops including maize, rice, cassava, and groundnuts.

As additional data are acquired from existing or new sources, the maps listed above should be updated and/or improved, and the content of the maps published by COMPASS should be expanded. Examples of maps the COMPASS team is planning to produce once the data have been acquired include the following:

- CBNRM Best Practice Sites.
- Distribution of Activities Promoting and/or Supporting CBNRM (who is doing what, and where).
- Distribution of Money Trading Organizations (banks, credit associations, etc.).
- Distribution of Small Grant Disbursements.

- Changes in Forest Cover since 1991.
- Changes in Suspended Sediment Yields in Malawi's Major Rivers.
- Distribution of CBNRM Co-Management Agreements.
- Distribution of Districts with Officially Sanctioned CBNRM Action Plans.
- Distribution of Communities Exposed to CBNRM Awareness Campaigns.
- Locations of Villages with Village Natural Resource Committees.

Some of the maps in these lists will be graphic representations of COMPASS performance indicators; others will represent more general facets of CBNRM practices in Malawi. As such, the maps will become useful tools for documenting the CBNRM initiatives of COMPASS and its CBNRM partners, and for monitoring and evaluating their performance and impact.

Members of the COMPASS Information Network need to be kept well informed about the availability of spatial data resources in Malawi. Doing this would help promote access to and more effective use of an extremely valuable resource. It would also help the COMPASS team and its partners monitor database development and identify gaps that need to be filled. Metadata reports modeled on those presented in Appendix III, the metadata reports should include directories of both digital and hardcopy spatial data holdings. **In addition to maps, COMPASS should publish and regularly update metadata reports documenting both its spatial data holdings and those of its CBNRM Partners.**

Form – COMPASS will begin by producing small-scale maps at the national scale. Data are not available yet to support detailed mapping of small areas at large scales. If and when the COMPASS databases expand to incorporate detailed spatial data at sub-district or even sub-EPA level, it might become necessary to increase the scale of the maps it publishes, but this is not likely to happen during the early stages of implementation.

Most COMPASS maps will be published in color, but it should be borne in mind that many of them will be photocopied in black and white - careful consideration should be given to map design to ensure that maps reproduced in this way can still be read and understood. To this end, the symbols used to represent features on maps should be selected carefully so that they can easily be interpreted. This is particularly true of text symbols that must be legible and meaningful to the audience. Where appropriate, local languages should be used in map legends and titles. It is essential to bear in mind the means by which the map will be disseminated, because symbols that clearly convey information on a color map projected onto a large screen may not be legible on a map that is printed in black and white and included in an A4-sized report.

Means of Dissemination – Maps and other outputs from the COMPASS GIS will be distributed and made accessible in many different ways. COMPASS will disseminate spatial information principally by the following means:

In addition to using the maps listed in Section 4.1 to illustrate its reports, newsletters and other largely text-based documents, COMPASS should publish a stand-alone Atlas. The CBNRM Atlas of Malawi could become one of the most important outputs from the COMPASS Information System**. The Atlas would serve three major functions. First, it**

Electronically	In Print
• COMPASS TAMIS • COMPASS Web Site • E-Mail • Storage Media (CD, Zip cartridge, diskette) • PowerPoint Presentation	• Reports • Newsletters • Information Sheets • Posters • Overhead Transparencies

would provide a record of COMPASS activities and achievements during the life span of the activity. Second, it would document the spatial distribution of the CBNRM activities of partner institutions and organizations. Third, it would keep readers informed about the general condition and distribution of Malawi's natural resource base. The target audience for the Atlas will be broad – it is anticipated that it will be useful to senior decision-makers, technical staff, extension workers and other field staff working for government, NGOs, donors, farmer and agribusiness associations, and other representatives of local communities.

COMPASS should plan to publish several editions of the Atlas over the next few years, providing not only snap shots of CBNRM-related activities at particular points in time, but also allowing readers to monitor changes from one edition to the next. The Atlas should be published both electronically and in hardcopy. Readers could then access the document on the COMPASS Web Site or via e-mail. Copies should be made available on appropriate electronic storage media for those who do not have access to the Internet. Printed Atlases should be published for partners and communities that do not use computers. **The target date for publishing the first edition of the COMPASS CBNRM Atlas of Malawi should be 30th June, 2000. COMPASS should aim to publish subsequent editions on an annual basis.**

4.2 Managing COMPASS's Spatial Databases

Spatial databases must be well managed if they are to be used effectively and efficiently. Database management responsibilities include design, development, quality control, security, and documentation. The purpose of all these tasks is to make spatial information accurate, easy to find, easy to use, accessible to the user community, and secure against loss or damage. Whilst it is beyond the scope of this report to present detailed instructions as to exactly how COMPASS should manage its spatial databases, the following sections point to some of the most important things to consider in striving to meet these objectives.

Design – Factors to consider in the design of a spatial database include content, format, structure and file-naming conventions. The current contents of COMPASS's spatial database have already largely been defined in Section 4.1. The database will expand as more is learned about the availability of and the demand for spatial information, but the themes listed serve as a good starting point to define the contents of the database.

The formats of the digital data COMPASS will use for mapping are determined by the software it uses. The programs it will most likely use for this purpose are ArcView, and the Microsoft Office suite comprised of PowerPoint, Word, Access and Excel. Using ArcView to manage the spatial data and generate maps, and then making those maps accessible to readers with one or more of the Microsoft programs is relatively simple and efficient as far as data format conversion is conerned. **ArcView shape files (.shp) should be the standard format for all COMPASS mapping files.**

The general procedure for converting ArcView maps into more useful formats is as follows. ArcView maps are assembled from one or more shape files displayed and symbolized in a "view". The view is then compiled in a "layout" together with other map elements such as a title, legend, scale bar and other text. Layouts are then exported as .wmf and .jpg files, both of which are compatible with other Microsoft Windows-based programs, including the Office suite. Using this standard procedure for compiling maps, COMPASS will be able to print its maps on paper or transparencies, display them on its Web Site, and incorporate them into PowerPoint presentations.

The structure of a spatial database refers to the way geographic and attribute files are stored on computer systems in directories and sub-directories. Personal preferences and work habits will determine to a large extent how a particular database is structured. Furthermore, even with the best planning and foresight, it is impossible to anticipate future data requirements completely – the structure of the database will have to evolve to accommodate unexpected additions. But with these qualifications in mind, some general rules can be applied to avoid common pitfalls.

- Make extensive use of directories and sub-directories
- Avoid putting all spatial data in one directory
- Keep the contents of individual sub-directories small and manageable
- Keep data from different sources in different directories
- Keep a master directory containing source files separate from directories containing derived files and working documents
- Design the database structure to be as flexible as possible to accommodate future inputs

The spatial database currently installed at COMPASS is limited to a small number of small-scale themes, maps and graphics, but already it is comprised of 71 directories and subdirectories, 944 files, and 90mb of data. A detailed description of its structure is not appropriate in this report, but a description of how the data are organized in general terms could be useful. The 5 top-level directories in COMPASS's GIS database are as follows:

Master Directory – contains all the master .shp files.
Working Directory – contains derived .shp (edits, overlays, buffers, etc.).
Project Directory – contains all ArcView project .apr files.
Source Directory – contains data from external sources in original formats.
Map and Graphic Directory – contains maps and graphics in .wmf and .jpg formats.

It is recommended that COMPASS archives the MasterDirectory of its spatial database as soon as possible for security and distribution purposes.

File-naming conventions are important to make files easily recognizable from their names, to distinguish "source" files from "derived" files, and to secure files against being accidentally

deleted or overwritten. For ease of recognition, clear, simple, descriptive text is preferable to numbers and abbreviations. Now that file names are no longer limited to 8-characters and spaces are allowed, it is not necessary to cut names short, use hyphens or under-scores, or use obscure codes made up of initial letters, numbers, and other symbols. The files listed in Appendix III-A were apparently named when the 8-character - no spaces limits applied, and many of them do not give a clear indication as to their content. Now these restrictions no longer apply, re-naming the files would make them easier to manage. Some suggestions for re-naming might include:

Current Name	New Name
ma_agclm	agro-climatic zones.shp
ma_adds	agricultural development divisions.shp
ma_fres	forest reserves.shp
ma_lc91	land cover 1991.shp
ma_regn	regions.shp

Development – Developing the COMPASS GIS database will involve collecting data from various sources, processing it into standard COMPASS formats, and fitting it into the structure defined during the design phase. Database development is a never-ending process because conditions on the ground are constantly changing, data sets are updated frequently to reflect those changes, and new data become available from previously untapped sources. The most challenging task for database developers is the first one – collecting the data.

COMPASS already has a reasonably good idea what data it would like to use and how it would like to use it; the main issue that needs to be addressed now is how to obtain those data. **Defining sources and a methodology for collecting data should be a priority for all members of the COMPASS team.** This is especially pressing for the data that will be used to monitor performance and the impact of CBNRM initiatives. The indicators for which geo-referenced data would be useful are listed in Section 2.2.3, but it is not yet clear how those data are to be collected, and how they are to be geo-referenced. Similarly, for non-spatial indicators such as the number of organizations and individuals registered as users of the Information System (TR2), or the percentage increase in family income generated by activities that are sanctioned by public and private sector agencies sponsoring CBNRM activities (overarching impact of CBNRM), defining *how* that information is to be collected, *when*, and *by whom*, needs to be done as soon as possible.

Another thrust of the database-building effort will be to continue to build COMPASS's holdings of spatial data from secondary sources. Examples of specific data sets identified during this assignment which need to be pursued include:

- The Starter Pack Scheme CD from DfID.
- Locations of PROSCARP sites.
- Historical weather data from FEWS or the Chileka Meteorological Office.
- Locations of hydrological stations from the Ministry of Water Development.
- Traditional Authority boundaries from the Survey Department.
- A full set of 1:250,000-scale topographic maps from the Survey Department.

Quality Control – Requirements for data quality depend to a large extent on the nature of the applications being developed. For the most part, COMPASS will not need great precision in its spatial databases because it will not be conducting sophisticated or detailed spatial analyses. COMPASS will be more concerned with computer mapping than with the analytical applications associated with larger, more technically oriented GIS operations. However, the quality of data cannot be ignored, and some level of quality control will be required. For example, when COMPASS is mapping data for Malawi's districts, it will be important to have boundaries for all 26 of them, but the precise location of those boundaries will not be a serious concern. As long as the districts are in their correct relative positions, and they are approximately the right shape, readers will recognize them, and the information that is being presented will be meaningful.

A quality assessment will be necessary in cases where data sets are available from more than one source. In such cases, the objective is to determine which version of the data set is most accurate and most useful, and discard the rest.

It is often extremely difficult to check the accuracy of source maps and statistical data, especially if they were generated some time in the past. Field verification is not an option because conditions in the field will have changed since the data were collected. Obtaining data from authorized sources is one way of improving one's chances of receiving accurate, complete data sets, although it is by no means a guarantee. Whenever secondary data are used, and especially in cases where data quality cannot be verified, it is important to cite the source of the data as precisely as possible. Another approach is to avoid using questionable data sets altogether, but some times that is not an option – it can be better to use "the best data available" than to use no data at all.

As far as digital mapping data are concerned, it may at least be possible to check the extent to which a source map was digitized accurately. Assuming that the checker has a copy of the source map, the technique for doing this is as follows. Print the digital version of the map (or part of the map) on a transparency at the same scale and using the same projection as the original. Then overlay the transparency on top of the source map. This makes it possible to determine whether or not the former is an accurate representation of the latter. Minor deviations can be edited and corrected, but if digitizing errors are substantial, the digital data should be discarded, and another source sought.

Security – GIS databases, and the applications developed from them, represent a major investment of time, money and effort. They are extremely valuable resources which, if lost or damaged, are often irreplaceable. The fact that the data are usually worth many times the value of the hardware and software in a GIS is frequently overlooked. Hardware and software can be covered by insurance policies and replaced. The only insurance for large databases is archiving and backing-up. As recommended above, baseline data sets (the Master Directory) and source data should be archived to a secure medium such as tape, CD or Zip cartridge. Of these three, CDs are the most secure and most durable. Frequent and regular backups of working databases are also essential – once-a-week is minimum for data that are updated and changed on a daily basis. Data archives and back-ups should be stored in a separate location from the working computers, preferably in a different building.

Documentation – COMPASS should prepare and maintain a number of different documents as part of its database management function. Most important of these are:

- A dictionary of digital spatial data holdings.
- A directory of printed map holdings.
- A catalog of maps published by COMPASS.
- A record of services and databases provided by other GIS units.

Not only will these documents help COMPASS staff keep track of the contents and structure of their databases, but they will also be available to inform others about the data resources held by COMPASS and other institutions. The first item in the list, the metadata dictionary, is particularly important as a database management tool. Information about data is vital if those data are to be used effectively and efficiently – only by keeping such a record up to data can the COMPASS team be confident that it "knows what it knows". The COMPASS Information Systems Specialist is already familiar with metadatabases through his work on the national Environmental Information System, and his experience will be extremely valuable in helping document the COMPASS GIS databases.

4.3 Supplementing COMPASS Human and Technical Resources

COMPASS is already collaborating with a wide range of organizations and institutions that together comprise the COMPASS Information Network. One important objective of this ongoing mutual support is to increase the productivity and effectiveness of CBNRM-related GIS efforts around the country. COMPASS will require substantial support to make the most of its limited GIS capacity, and it has already begun to identify opportunities for collaborating on database development, data processing, and the production of GIS outputs. Key partners in its efforts to date include PROSCARP, FEWS, the Land Resources Conservation Department, EAD and the Survey Department, all of which have provided COMPASS with spatial data and/or information. One way of strengthening the relationships among these partners would be to form a Malawi GIS **Users' Group. COMPASS should take the initiative in this regard and try to revive interest in MAGIC.**

In addition to working with agencies like those listed above, COMPASS will be seeking support from the NGO and private sectors. Not only should COMPASS be exploring opportunities for tapping these sources for data, but it should also be seeking to identify GIS firms and technicians in these sectors with a view to hiring their services on a short-term basis. The Information Systems Specialist does not have the technical resources or the time to do all the hands-on work needed to operate the COMPASS GIS effectively. CURE is seen as a key partner in this regard, and discussions have already taken place concerning the possibility of collaborating on GIS.

In general terms, it is recommended that COMPASS provides funds for CURE to establish a modest GIS capability of its own. Through a small grant or some other mechanism, CURE would purchase a computer, an ArcView update (they already own a copy of ArcView 3.0a), a digitizer tablet and a printer or plotter. CURE staff would receive training through a COMPASS-funded course, and they would also receive copies of COMPASS's digital spatial data holdings. In return, the newly trained staff at CURE would be available to assist COMPASS in a number of areas, including data collection and the production of the

COMPASS CBNRM Atlas of Malawi. If it goes ahead, this arrangement will help to serve COMPASS's immediate need for manpower support and at the same time initiate a process towards sustaining GIS initiatives beyond the life of COMPASS. **COMPASS and CURE should start working together on GIS as soon as possible so that if and when CURE takes over responsibility for the COMPASS GIS they will know how to use it.**

In more general terms, COMPASS is planning to build GIS capacity in Malawi by providing training. A training needs assessment was completed by a COMPASS short-term consultant in September, and one of the needs identified among CBNRM partners in that study was for training in GIS (Mwakanema, 1999). However, the details of a GIS training program are still being worked out, and one of the first steps in that process is to determine exactly who needs training, and in what aspects of GIS.

GIS as a technical discipline is very broad, and different types of training are required for people with different interests in it. For example, field staff responsible for collecting data need training in survey techniques, record-keeping and reporting. GIS technicians and analysts need to know how to operate computers to input, process, and analyze digital spatial data, and to generate useful and meaningful outputs. They also need a sound knowledge of basic cartographic concepts and principles such as map scales, projections, and map design. A third group, which includes managers, supervisors and other decision-makers, do not need to know the nuts and bolts of how a GIS works, but they should know what types of outputs a GIS can generate, and how to use those outputs as decision-support tools. They should also understand the processes of developing, running and maintaining a GIS so that they provide appropriate support and direction to their technical staff. Finally, the managers should have a good understanding of the costs of running a GIS operation, because it is they who will be responsible for distributing budgets, staff and other resources among their various technical and administrative units. **COMPASS should conduct a detailed GIS training-needs assessment among its CBNRM partners, and develop a training program based on the results.**

4.4 Additional Equipment, Software and Supplies

COMPASS needs a few more items of hardware to support its GIS facility. One of the most important issues to address is data security. At present there are no means of backing-up valuable data sets at the COMPASS office, although measures have been taken to address this issue (a Zip drive is on back-order from the U.S.). A CD writer is excellent for creating archives and producing CDs of COMPASS documents and databases for distribution. A GPS receiver is considered essential for field work, especially for geo-referencing best practice and grant-disbursement sites, but also for verifying the accuracy of maps and remote sensing images. A digital camera would also be useful for capturing images that could be hot-linked to maps either in the COMPASS GIS or on its Web Site. A color printer will certainly be required for generating a wide range of documents, including newsletters, best practice bulletins and the COMPASS Atlas.

The following items are considered essential for COMPASS operations:

Item	Cost Estimate (US$)
CD Writer	300
Iomega Zip Drive (includes 6x100mb cartridges)	200
HP Deskjet 895C A4 Color Printer	700
Magellan ColorTrak GPS Receiver	300
HP 4C Color scanner	350
Digital Camera	500

Certain items are essential, and some can be considered optional. Among the former are a CD writer, a Zip drive, at least one GPS receiver, a color printer and a complete set of topographic maps. Optional items include a scanner and a digital camera. Cost estimates are based on U.S. prices (local prices were found to be much higher).

References

Copies of the documents listed below can be obtained from the COMPASS office, Phekani House, Glynn Jones Road, Blantyre. Tel: 622800.

Community Partnerships for Sustainable Resource Management in Malawi (COMPASS), 1999. *First Workplan (July 1st to December 31st 1999).* COMPASS, Blantyre.

Coordination Unit for the Rehabilitation of the Environment (CURE), 1998. *Cure Gender Directory; A Directory of Organizations Involved in Gender and Natural Resource Management Activities in Malawi.* CURE, Blantyre.

Coordination Unit for the Rehabilitation of the Environment (CURE), 1997. *Directory of Non-Governmental Organizations Involved in Natural Resource Management Activities in Malawi.* CURE, Blantyre.

Cutler, J. 1999. *Geographic Information Systems Final Report*. Published under the Promotion of Soil Conservation and Rural Production (PROSCARP) project by the Land Resources Conservation Department of the Ministry of Agriculture, and Irrigation, Lilongwe.

Kapila, M.L.M. 1999. *Malawi Environmental Information System (EIS); Consultancy Report.* Published under the Environmental Management Project (EMP) by the Environmental Affairs Department of the Ministry of Forestry, Fisheries and Environmental Affairs, Lilongwe.

Mkandawire, V.A.L. 1999. *Review of Available Geographic Information System Facilities.* Strategy and Policy Paper for the Conservation and Rehabilitation of the Watersheds of the Kamuzu and Mulunguzi Dams. Land Resources Conservation Department, Lilongwe.

Mwakanema, G. 1999. *Training Needs Assessment, Responsive Modules and Training Approach.* (Draft). COMPASS, Blantyre.

Appendix I – Scope of Work

BUILDING GIS CAPABILITIES WITHIN THE COMPASS INFORMATION SYSTEM

Through this assignment, the COMPASS Team will assess options for building a capacity for storing and analyzing information in a spatial context. We will determine which existing spatial databases it would be valuable to integrate with the proposed COMPASS Information System. We will also identify and evaluate different design options and, having selected the most useful and cost-effective alternative, we will prepare an action plan for its installation and implementation.

Background/Justification

The COMPASS Information System will house data relating to a host of different activities in the field of community-based management of natural resources throughout Malawi. We will compile and synthesize information on the activities of different donor organizations, government agencies, NGOs and the private sector that pertain to the use of natural resources, to capacity building within organizations that promote CBNRM and to the training and mobilization of natural resource users.

The bulk of this information relates to specific resources such as woodlands, protected areas, fisheries, water resources and so on that are found in discrete geographical locations. The activities that are underway to improve the management of these resources and to mobilize community groups are also being implemented in places that are spatially discrete (National Parks, specific Districts or areas or villages). In effect, these data are readily geographically referenced (geo-coded) and their distribution is described most usefully in spatial terms (where they are). Hence, the use of a Geographic Information System for storing, managing and analyzing these data would greatly benefit the COMPASS Information System.

In addition, to providing information on the nature and distribution of CBNRM activities in Malawi to promoters and practitioners, COMPASS is also charged with monitoring the performance and impact of initiatives that are implemented through the Activity. Efficient management, analysis and reporting of the information would also benefit from geo-coding the data and having the ability to present data sets on maps.

Objective:

The goal of the assignment is to identify and evaluate the different options for building the capacity to manage CBNRM data using a Geographical Information System or similar tools. The Technical Assistant will work with the COMPASS team to select the best option (most useful and cost-effective) and will develop procedures for linking this to the COMPASS TAMIS.

Tasks:

This short-term assignment is comprised of seven tasks.

Task 1: Assess the availability of existing spatial information in electronic form. Contact COMPASS Partner organizations to determine what databases are currently in use and the quality of the data that is available (is it accurate and up to date?).

Task 2: Assess the value of these data sets to COMPASS and to COMPASS Partners. Is the information useful and is it available in a form that allows it to be readily used?

Task 3: Identify gaps in the availability and accessibility of spatial data that will be improve the utility of current data sets.

Task 4: Identify viable options for integrating a GIS capability into the COMPASS Information System (including TAMIS). Provide detailed information on the costs of the alternatives in terms of hardware and software requirements, training needs and data acquisition requirements.

Task 5: Discuss the alternatives with the COMPASS Team members and other key partners. Determine the best option based on utility, cost-effectiveness and anticipated long-term needs.

Task 6: Design linkages between the selected GIS capability and the COMPASS TAMIS and other components of the COMPASS Information System. Particular attention should be paid to the use of the GIS facility for work planning, information exchange and for monitoring and evaluation (for CBNRM in Malawi, for COMPASS performance and impact monitoring, and for small grants).

Task 7: Prepare a step-by-step action plan for installation and implementation of a GIS capability for the COMPASS Information System. This should include a detailed desription of hardware and software requirements, training needs, and recommendations for data acquisition, management and maintenance of the system.

Outputs and Deliverables:

A report describing the existing spatial databases relating to CBNRM in Malawi, identifying potential users and the benefits to them of improved GIS capacity. A detailed action plan for providing COMPASS with a GIS capacity integrated into the existing (and proposed) Information System.

Work Schedule and Reporting Relationship:

24 working days between September 20th to October 16th 1999.

Days 1 – 10: Meet with key COMPASS Partners involved in information management and catalog all spatial data sets that are currently in use or under development. Assess

capabilities and needs of key Partners in collecting, managing and using spatial information.

Days 11-20: Summarize finding and identify options for a viable COMPASS GIS capability.

Days 21-24: Develop an action plan for installation and implementation of a COMPASS GIS capacity and, where possible, begin structuring and configuring the existing Information System to allow efficient management of spatial data.

Reporting: The GIS Specialist will report to the COMPASS Chief of Party, Andrew Watson, and to the COMPASS Information Systems Specialist, Mesheck Kapila.

Qualifications:

The specialist should be familiar with a wide array of approaches to managing spatial information and should be aware of the capacity building requirements inherent in developing GIS in a setting where infrastructure is limited and local expertise is not widely available. The specialist must also have a sound understanding of DAI information systems management and of the COMPASS TAMIS.

Appendix II – Useful Contacts

Co-ordination Unit for the Rehabilitation of the Environment (CURE), Blantyre
Mr. Robert Kafakoma, Executive Director
Tel: (265) 645757
Fax: (265) 645492
E-Mail: cure@malawi.net

Environmental Affairs Department (EAD), Ministry of Natural Resources and Environmental Affairs, Lilongwe
Mr. Alex Banda
Mr. Mazibuko, Coordinator, Environmental Information System (EIS)
Mr. John Malunga, Outreach and Education
Tel: (265) 781111

Department of Forestry, Ministry of Natural Resources and Environmental Affairs, Lilongwe
Mr. Leo Zulu, Principal Biodiversity Officer, SADC
Mr. Patrick Jambo, GIS Technician
Mr. Joseph Mlotha, GIS Technician
Tel: (265) 781000, 781417, 781160, 781034, 781301

Famine Early Warning System (FEWS), Agro-Economic Survey Offices, Ministry of Agriculture and Irrigation, Lilongwe
Mr. Sam Chimwaza, FEWS Country Representative
Mr. Evance Chapasuka, Deputy FEWS Country Representative
Tel: (265) 744083; 825051, 721877
Fax: (265) 744083
E-Mail: Fewsmw@malawi.net

Forum for Environmental Communications, Blantyre
Mr. Anthony Livuza, Chairman
Tel: (265) 620170, 620266, 620311
Fax: (265) 832909
E-Mail: alivuza@malawi.net

Department of Land Resources Conservation, Ministry of Agriculture and Irrigation, Lilongwe
Mr. Steve Nanthambwe, Deputy Director
Mr. Vincent Mkandawire, Head of GIS Unit
Tel: (265) 740467
Mobile: (265) 830048 (Mkandawire)

Department for International Development (DfID), British High Commission, Lilongwe
Dr. Harry Potter, Natural Resources Advisor; Field Manager, Malawi
Tel: (265) 782400
Fax: (265) 782657
E-Mail: H-Potter@DFID.gov.uk

Malawi Net, Blantyre
Mr. Thoko Medi
Tel: 622436, 622596

Mines Department, Government of Malawi, Lilongwe
Mr. Leonard Kalindekafe, Acting Director of Mines
Tel: (265) 722933, 722194, Direct 720843
Mobile: (265)834041
Fax: (265) 722772
E-Mail: Mkalindekafe@Unima.wn.apc.org

Promotion of Soil Conservation and Rural Production (PROSCARP), Lilongwe
Mr. John Dickinson, Natural Resources Management Advisor
Tel: (265) 743066
Fax: (265) 740704
Mobile: (265) 834633
E-Mail: Agrotec@malawi.net

Survey Department, Government of Malawi, Blantyre
Mr. Gresham Gunda, Surveyor General
Mr. Geoff Mzembe, Senior Cartographer, Assistant Head of Map Office

United States Agency for International Development (USAID), Lilongwe
Mr. Wayne MacDonald
Mr. Steve Machira, Contracting Officer's Technical Representative (COTR), COMPASS
Tel: (265) 782237, 782197,782455
E-Mail: smachira@usaid.gov

Appendix III – Directory of COMPASS Spatial Data Holdings

COMPASS PRINTED MAP HOLDINGS

A. Land Resources Appraisal Maps

Coverage: National; 8 sheets, one for each of Malawi's Agricultural Development Divisions

Scale: 1:250,000

Publisher: Survey Department of Malawi under the Ministry of Agriculture's Land Resources Evaluation Project with UNDP/FAO support.

Agricultural Development Division	Title of Map	Date Printed
Karonga	Map 1 – Soils/Physiography	1991
	Map 2 – Agro-Climatic Zones	1991
	Map 3 – Land Units	1991
	Map 4 – Present Land Use and Vegetation	1991
	Map 5 – Land Suitability for Maize	1991
	Map 6 – Land Suitability for Cotton	1991
	Map 7 – Land Suitability for Tobacco	1991
	Map 8 - Land Suitability for Beans	1991
Mzuzu	Map 1 – Soils/Physiography	1992
	Map 2 – Agro-Climatic Zones	1992
	Map 3 – Land Units	1992
	Map 4 – Present Land Use and Vegetation	1992
	Map 5 – Land Suitability for Maize	1995
	Map 6 – Land Suitability for Groundnuts	1995
	Map 7 – Land Suitability for Tobacco	1995
	Map 8 - Land Suitability for Sunflower	1995
	Map 9 - Land Suitability for Cassava	1995
Kasungu	Map 1 – Soils/Physiography	1992
	Map 2 – Agro-Climatic Zones	1992
	Map 3 – Land Units	1992
	Map 4 – Present Land Use and Vegetation	1992
	Map 5 – Land Suitability for Maize	1993
	Map 6 – Land Suitability for Groundnuts	1995
	Map 7 – Land Suitability for Tobacco	1995
	Map 8 - Land Suitability for Sunflower	1995
	Map 9 - Land Suitability for Sorghum	1995

Agricultural Development Division	Title of Map	Date Printed
Salima	Map 1 – Soils/Physiography Map 2 – Agro-Climatic Zones Map 3 – Land Units Map 4 – Present Land Use and Vegetation Map 5 – Land Suitability for Maize Map 6 – Land Suitability for Groundnuts Map 7 – Land Suitability for Tobacco Map 8 - Land Suitability for Cotton Map 9 - Land Suitability for Wetland Rice	1992 1992 1992 1992 1995 1995 1995 1995 1995
Liwonde	Map 1 – Soils/Physiography Map 2 – Agro-Climatic Zones Map 3 – Land Units Map 4 – Present Land Use and Vegetation Map 5 – Land Suitability for Maize Map 6 – Land Suitability for Cotton Map 7 – Land Suitability for Sunflower Map 8 - Land Suitability for Soyabeans	1991 1991 1991 1991 1991 1991 1991 1991
Blantyre	Map 1 – Soils/Physiography Map 2 – Agro-Climatic Zones Map 3 – Land Units Map 4 – Present Land Use and Vegetation Map 5 – Land Suitability for Maize Map 6 – Land Suitability for Groundnuts Map 7 – Land Suitability for Cotton Map 8 - Land Suitability for Coffee (Arabica)	1991 1991 1991 1991 1991 1991 1991 1991
Ngabu	Map 1 – Soils/Physiography Map 2 – Agro-Climatic Zones Map 3 – Land Units Map 4 – Present Land Use and Vegetation Map 5 – Land Suitability for Maize Map 6 – Land Suitability for Bulrush Millet Map 7 – Land Suitability for Groundnuts Map 8 - Land Suitability for Cotton	1991 1991 1991 1991 1991 1991 1991 1991

B. Land Cover Maps

Scale: 1:250,000
Publisher: Satellitbild in cooperation with the Department of Forestry
Date: 1990/91
Data Source: Landsat Thematic Mapper satellite imagery.
Sheets: Sheet 1 – Karonga; Sheet 2 – Nyika; Sheet 3 – Mzuzu;
Sheet 4 – Nchotakota; Sheet 5 – Lilongwe; Sheet 6 – Salima;
Sheet 7 – Dedza; Sheet 8 – Mangochi; Sheet 9 – Blantyre; Sheet 10 – Nsanje.
Note: COMPASS also has a 1:1,000,000-scale Land Cover Map of Malawi from the same source, compiled by aggregating the 1:250,000-scale land cover classes.

A. Digital Geographic Data

1. GIS Data from the Public Lands Utilization Study (PLUS)

File Name	Description	Attribute Field Name	Attribute Description
ma_adds	National ADD boundaries	hectares	area in hectares
		km_sq	area in square kilometers
		add	ADD name
		count	
		add-abrev	ADD name abbreviated
ma_agclm	National agroclimate	climzone	primary climatic zone code, LREP
		climzon2	secondary climatic zone
		hectares	area in hectares
		km_sq	area in square kilometers
		aczone	agroclimatic zone code, LREP
		lgp	reference length of growing period, days
		ppet	ratio of precipitation to potential evapotranspiration
		tgp	mean temperature during growing period, C
		pan	mean annual precipitation, millimeters
		dm	mean number of dry months per year
		tan	mean annual temperature, centigrade
		tmin	mean minimum temperature during coldest month, C
		tegp	mean temperature during end of growing period, C
ma_agsch	National agricultural schemes	hectares	area in hectares
		scheme_nam	ag scheme name
		scheme_id	sequential identification number
ma_airpt	National airports	aepoint_	sequential identification number
		aepoint_id	sequential identification number
		aepttype	airport type, numeric code
		aepttypetx	airport type, text
		aeptname	airport name
		aeptval	airport elevation value
		aeptdate	data revision date
		aepticao	international civil aviation organization number
		aeptdkey	DAFIF reference number
		long	airport longitude, decimal degrees
		lat	airport latitude, decimal degrees
ma_bordr	National border	n/a	n/a
ma_city	National cities	pppoint	arc/info internal number
		pppoint_id	arc/info internal number

File Name	Description	Attribute Field Name	Attribute Description
		pppttype	point feature type code (see below)
		pppttypetx	1=no subcategories; 2=associated with city polygons
		ppptname	city name
		ppptflag	flag code 1=standard or regular characters 2=diacritical marks or special characters required 9=no name associated with feature
		long	city longitude in decimal degrees
		lat	city latitude in decimal degrees
		popul87	city population, 1987
ma_dist	National districts	hectares	area in hectares
		km_sq	area in square kilometers
		dist_name	district name
		dis_popul	district population, 1987
ma_epas	National extension planning areas	hectares	area in hectares
		km_sq	area in square kilometers
		zid	FEWS identification code
		popdns87	inhabitants per km-sq, 1987
		zname	EPA name
		zname2	numeric name code
		sam_id	numeric code assigned by "Sam" in Malawi
		pop87	EPA population, 1987
ma_fprop	National proposed forest reserves	name	proposed forest reserve name
		status	status code
		major1	
		minor1	
		hectares	area in hectares
		km_sq	area in square kilometers
ma_fres	National Forest Reserves	hectares	area in hectares
		km_sq	area in square kilometers
		name	forest reserve name
		type	numeric reserve type code (100=forest res.)
ma_lakes	National lakes	hectares	area in hectares
		km_sq	area in square kilometers
		name	lake name
		dnnet#	(redundant)
		dnnet-id	(redundant)
		dnpytype	numeric lake type code (1=perennial)
		dnpytypetx	lake type text (e.g. "perennial")
ma_lc73	National 1973 MSS land cover	hectares	area in hectares
		km_sq	area in square kilometers
		landcode	1973 land cover type code, numeric 300 = Evergreen woodland 301 = Miombo in hilly area 302 = Miombo in flat area

File Name	Description	Attribute Field Name	Attribute Description
			303 = Eucalyptus plantation
			304 = Gmelina plantation
			305 = Pine plantation
			306 = Rubber plantation
			307 = Tung plantation
			308 = Logged area
			324 = Water surface
			399 = Not classified
		name	land cover type name, text
		abbrev	land cover type abbreviation (e.g. "Fbh", "Fe")
		status	(no data)
ma_lc91	National 1991	hectares	area in hectares
	TM landcover	km_sq	area in square kilometers
		landcode	1991 land cover type code, numeric
			200 = Evergreen woodland
			201 = Miombo in hilly area
			202 = Miombo in flat area
			203 = Eucalyptus plantation
			204 = Gmelina plantation
			205 = Pine plantation
			206 = Rubber plantation
			207 = Tung plantation
			208 = Logged area
			209 = Grass
			210 = Dambo
			211 = Savanna
			212 = Agriculture in forest area
			213 = Agriculture in grass area
			214 = Arable land
			215 = Coffee & Tea
			216 = Sugar
			217 = Tobacco & Maize
			218 = Leucaena
			219 = Rice scheme
			220 = Marshy area
			221 = Bare rock
			222 = River bed or bare ground
			223 = Built-up area
			224 = Water surface
			299 = Not classified
		name	land cover type name, text
		abbrev	land cover type abbreviation (e.g. "Fbh", "Fe")
		status	(no data)
ma_parks	National	hectares	area in hectares
	National Parks	km_sq	area in square kilometers
		parkname	park name
ma_pop4	National potential	hectares	area in hectares

File Name	Description	Attribute Field Name	Attribute Description
	population pressure	km_sq	area in square kilometers
		zid	FEWS identification code
		popdns87	inhabitants per km-sq, 1987, by whole EPA
		popdnsmod	1987 pop. density by EPA, excluding area within reserves
		pop87	EPA total population, 1987
		zname	EPA name, text
		zname2	EPA numeric code
		sam-id	identification code asigned by "Sam" in Malawi
		oarea	original total EPA area
ma_prot	National protected areas	hectares	area in hectares
		km_sq	area in square kilometers
		name	reserve name, uppercase text
		type	reserve type, numeric code
		type_txt	reserve type, text
		name_low	reserve name, lowercase text
		prot_date	protection date
		gaz_date	gazettement date
		gaz_decade	gazettement decade
		gaz_1964	gazettement 1964 or earlier (1=yes, 2=no)
		add_date	
		rationale1	primary creation rationale, text (e.g. "catchment protection")
		r1_code	primary creation rationale, numeric code
		rationale2	secondary creation rationale, text
		r2_code	secondary creation rationale, numeric code
		rationale3	additional creation rationale, text
		r3_code	additional creation rationale, numeric code
		rationale4	additional creation rationale, text
		r4_code	additional creation rationale, numeric code
		buffer_pop	1987 population within 5km of reserve
ma_regn	National regions	hectares	area in hectares
		km_sq	area in square kilometers
		rname	region name (e.g. "north", "center", "south")
ma_soils	National soils	hectares	area in hectares
		km_sq	area in square kilometers
		soil-id	polygon identification code
		soil_type	alphanumeric soil type code (e.g. "LVh7", "LPe5")
		dom_soil	(no data)
		assoc_1	primary soil association, alphanumeric code (e.g."Cme")
		assoc_2	secondary soil association, alphanumeric code
		assoc_3	additional soil association, alphanumeric code
		assoc_4	additional soil association, alphanumeric code
		ass_per	(no data)
		includ_1	primary soil inclusion type code (e.g."Fle", LPm")
		includ_2	secondary soil inclusion type code
		includ_3	additional soil inclusion type code

File Name	Description	Attribute Field Name	Attribute Description
		includ_4	additional soil inclusion type code
		inc_per	(no data)
ma_strms	National streams	dnnet#	(redundant)
		dnnet-id	(redundant)
		dnlntype	drainage network line type code, numeric
		dnlntypetx	drainage network line type description, text
		dnlnstat	drainage line status
		dnlnstattx	drainage network line status description (e.g."perennial")
ma_trans	National transportation routes	sym	line symbol code, numeric
ma_utm	National UTM grid	n/a	n/a
ma_utm_c	National UTM grid, clipped	n/a	n/a
ma_wres	National Wildlife Reserves	hectares	area in hectares
		km_sq	area in square kilometers
		wresname	wildlife reserve name, text
ma_dem	National digital elevation model	value	elevation

B. Digital Attribute Data

1. Agricultural Production Data

Description: Agricultural data for 13 different crops in 154 Extension Planning Areas (EPAs). 1984-1998 for 5 crops; 1994 – 1998 for 8 crops.

Crops:				
	Long Season Maize	1984-1998	Sweet Potato	1994-1998
	Hybrid Maize	1984-1998	Tobacco	1994-1998
	Composite Maize	1994-1998	Rice	1984-1998
	Cassava	1984-1998	Groundnuts	1984-1998
	Pulses	1994-1998	Millet	1994-1998
	Sorghum	1994-1998	Cotton	1994-1998
	Potato	1994-1998		

Format: 3 Microsoft Excel (xls) files
EPAAREA.XLS – annual area planted to each crop (hectares)
EPAYIELD.XLS – average yield of each crop (tonnes/hectare)
EPAPROD.XLS – annual production (tonnes)

Source: FEWS, Lilongwe

Appendix IV – Internet Resources for CBNRM and GIS

The following are Web sites and e-mail contacts that are likely to be of interest to COMPASS partners interested in GIS. Some of the sites listed present information about GIS applications in natural resources management. Others are oriented more specifically towards providing support and networking opportunities for GIS technicians and analysts. The list is necessarily a personal and very small sample of the resources available via the internet.

http://www.cnr.berkeley.edu/~getz/savegame.html

Southern African Veld Ecosystems Geographic Assessment & Monitoring Effort (SAVE GAME)

The purpose of SAVE GAME is to develop a wildlife monitoring and assessment program across game-rich rural areas of Southern Africa, operating at the grassroots level of indigenous rural communities, for the purpose of providing local wildlife managers with the technology, expertise, and information they require to manage their own resources, using established ecological and bioeconomic principles.

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http://ag.arizona.edu/OALS/oals/arsc/arsc.html
http://ag.arizona.edu/OALS/oals/arsc/memp.html

University of Arizona GIS sites, including the MEMP site from the Malawi Environmental Monitoring Project which OALS helped implement.

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http://www.gis.umn.edu/rsgisinfo/rsgis.html

University of Minnesota about remote sensing and GIS resources on the Internet.

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http://www.geocities.com/CollegePark/Library/7798/

The Vancouver GIS Users Group site – a good example of the what a users' group is, and what kinds of things it does.

The Vancouver GIS Users Group is a group of GIS professionals using geographic information systems for spatial data management, analysis, and visualization. Formed to facilitate communication between people working in all areas of GIS, the users' group meets monthly to allow its members to learn more about current activities and technologies within the industry and to network with their peers.

http://www.esri.com/

The Environmental Systems Resource Institute (ESRI) publishes the ARC/INFO and ArcView family of software, as well as data, books, and maps. They also provide training and technical support, and they organize conferences, workshops and seminars. The following are useful contacts for finding out more about the activities of a number of specialist ESRI users' groups.

Environmental Management Users' Group
Coordinator: Sara Moola, ESRI
Telephone: (909) 793-2853, extension 1841
E-mail: smoola@esri.com

Forestry Users' Group
Coordinator: Jack McCarthy, ESRI-Denver
Telephone: (303) 449-7779
E-mail: jmccarthy@esri.com

Agriculture Users' Group
Coordinator: Max Crandall, ESRI
Telephone: (909) 793-2853, extension 2309
E-mail: mcrandall@esri.com

URL: http://www.gims.com

Based in South Africa, GIMS is the regional distributor for ESRI. GIMS recently conducted a Users' Conference and will soon publish the proceedings from that conference on its Web site. The site offers a long list of useful links to other potentially interesting GIS sites.